Effect of Light Curing Method on the Degree of Conversion of Light Cured Resin Cement through Different Lithium Based Ceramics

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Introduction

All ceramic materials are becoming interesting because of their suitable physical and mechanical properties, esthetics, and biocompatibility which renders them appropriate for dental rehabilitation.[1] All-ceramic restorations success is determined mainly on the bonding between hard dental tissues and ceramic by the dental cements. Developments in adhesive dentistry, especially in resin cements made the usage of ceramic restorations more attractive as resin cement offer low solubility, good esthetics, and proper bond strength to restorative materials and tooth substrate.[2]

The strength of the bond is largely affected by the degree of conversion of the resin cement. The term “Degree of Conversion” (DC%) , refers to the conversion of monomeric carbon-carbon double bonds into polymeric carbon-carbon single bonds.[3] Increasing the conversion results in higher surface hardness, flexural strength, fracture toughness, and tensile strength. This improvement in properties may be due to the increased cross-linkage.[4]

Inadequate polymerization, which is described as low degree of conversion reduces the mechanical properties of the cement and results in increase in solubility and water sorption. Moreover, it is proved that high amounts of residual monomers could cause pulp irritation and thus irreversible pulpitis.[5] Insufficient DC% negatively affects the mechanical properties, alter dimensional stability, and decreasing the bond between the resin cements and tooth substrate, thus prejudicing the clinical longevity of the restoration.[6]

Factors that affect the degree of conversion include: type of ceramic, its thickness, translucency and shade, the resin cement composition, activation method, in addition to the curing light output power, mode, adjusted setting time, and distance from the cement and restoration.[7]

Adequate polymerization of light cured resin cement is crucial for the longevity of the ceramic restoration.[8] The quality of light and the curing mode are important factors that affect polymerization and thus the clinical performance of the resin composite restoration.[9] Appropriate energy density is important for obtaining a high degree of conversion (DC%). Different curing modes can influence the hardness of the resin cement. Energy density is determined by the curing light intensity and exposure time.[10]

Assessing the way in which the type of ceramic system, mode of light curing, and shade of resin cement can affect the degree of conversion of light cured resin cements can greatly assist the operator in achieving the highest possible DC% which will contribute to more favorable bond strength, and therefore higher success of the restoration over longer periods of time.

As the mode of application of light curing vary in daily practice; hence this in-vitro study was set to determine the possible effect of two light curing modes on the degree of conversion of two shades of light cured resin cements through different ceramic materials.

Review of Literature

The use of all ceramic prosthesis in restorative treatments has become popular in restoring defective or missing teeth. Dental ceramics are used as restorative materials to provide esthetic realism. These ceramics restorations can be fabricated by both traditional laboratory methods or via Computer Aided design/ Computer Aided Manufacturing (CAD/CAM) technology.[11]

Traditional methods of ceramic fabrication have been described to be time-consuming, technique sensitive and unpredictable due to many variables. These traditional methods include powder/liquid building, slip casting, and hot-ceramic pressing.

On the other hand, CAD/CAM technology is a good alternative for both dentists and technicians. The use of CAD/CAM technology expanded machinable ceramic fabrication by allowing scanning, designing, and milling of either a full-contoured restoration or a single/multiple unit framework by computer.[12] Industrially fabricated blocks for CAD/CAM use offer a more homogenous material with minimal flaws and more favorable properties.[13]

The evolution of CAD/CAM technology for the production of machined laminate veneers, inlays, onlays, and crowns led to the development of new generations of machinable ceramics.[14]

Laminate Veneers:

Laminate veneer restorations have gained increasing popularity for esthetic improvement for anterior teeth. Veneers have been reported

to be durable conservative anterior restorations with superior esthetics. The treatment of discolored, fractured or congenitally malformed teeth, as well as esthetic shaping of anterior teeth and elimination of diastemas requiring full-coverage restorations are accomplished via the use of veneers.[15]

Laminate veneers within reason allow for the alteration of tooth position, shape, size and color.[16] Laminate veneer restorations are considered as minimally invasive treatment options. This restorative alternative allows a substantial reduction of the ceramic thickness in accordance with the concept of minimally invasive dentistry, which emphasizes the use of high-resistance materials in association with adhesive luting techniques to restore teeth.[17] No longer is it necessary to remove 1.0 to 1.5 mm of tooth structure to retain a porcelain restoration via a ferrule design and frictional retention. Instead, a laminates are retained with little or no tooth preparation.[18] [19]

Modern restorative dentistry is essentially based on adhesion. This allows it to comply with three vital parameters: esthetics, function, and sound tissue preservation. The correct use of ceramic materials and proper adhesive procedures allows for a minimally or even noninvasive (ie, additive) approach that is innovative, highly esthetic, and predictable in terms of both result and long-term prognosis.[20]

The durability of laminates relies on the adhesive strength of resin luting cement to the veneering material and the tooth surface.[21] Long-term success of veneers is determined by material properties and fatigue resistance of ceramic and adhesive/ luting cement systems used.

Further factors for clinical success are marginal adaptation of the veneer restoration, tooth preparation design, functional and morphological condition of the abutment tooth.[22]

The impact of the acid etch technique on restorative dentistry continues to reverberate. Instead of relying on specific cavity design parameters for either frictional or undercut retention features, microscopic resin tags have become the preferred attachment mechanism for many dental restorations.[23]

D'Arcangelo et al in 2011[24] examined the clinical performance of laminate porcelain veneers which are cemented with a light-cured resin cement. The porcelain laminate veneers in this study were observed over a period of 7 years. They clinically evaluated the marginal discoloration and adaptation of the laminates, in addition to color match, anatomical form and secondary caries of teeth. The effect of veneers on the gingival response was satisfactory. As a conclusion, porcelain laminate veneers offered a successful treatment option giving a maximum preservation of sound tooth structure.

Barizon et al in 2014[25] conducted a study to compare the relative translucency of the different types of ceramic systems indicated for porcelain veneers and to evaluate the effect of shade and thickness on translucency. It was concluded that translucency was affected by the thickness of the restoration more than the shade of the ceramic used.